MODIS DATA STUDY
TEAM PRESENTATION

November 9, 1990

AGENDA

1. Action Items
2. MODIS Level-1 Processing System Functional Requirements Overview
3. Revised MODIS Level-1 Processing Context Diagram
4. MODIS Level-1A Processing System Functional Requirements Overview

ACTION ITEMS:

10/5/90-2 [Doug Hoyt]: Examine MCST documentation and identify missing or additional information items that the MODIS Data Study Team will need to complete the specification of MODIS processing. STATUS: Presentation given at 10/19/90 meeting. Doug Hoyt to revise list of questions. Materials have been drafted and are awaiting review by D. Han. Open.

10/12/90-2 [Watson Gregg]: Prepare a report on MODIS anchor point requirements. Analyze the utility of alternative parameters to describe MODIS observation and solar geometry. STATUS: Work in progress. Open.

10/19/90-1 [John Blaisdell]: Expand introductory material in Earth Model write-up to include broad discussion of MODIS geolocation and need for Earth model. Coordinate with Al Fleig to distribute report. STATUS: Met with Al Fleig. Open.

10/26/90-1 [John Blaisdell]: Scope a brief error analysis and impact study on the merits of a geoid model as opposed to an ellipsoid. STATUS: Open.

MODIS LEVEL-1 PROCESSING SYSTEM FUNCTIONAL REQUIREMENTS OVERVIEW

Many of the functional requirements listed below are inherited from a higher level. They are included here because we focus on Level-1 data processing.

A. INPUT

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL RECEIVE:

1. Level-0 Data

   (Page 7-23, 3PGS-00440: The PGS shall accept from the DADS L0-L4 Data Sets.)

2. Ancillary Data

   (Page 7-23, 3PGS-00450: The PGS shall accept from the DADS Ancillary Data Sets.) Received information shall contain at a minimum: (a) Instrument Status Information and (b) Spacecraft Ancillary Data.

3. Quick-Look Data

   (Page 7-24, 3PGS-00530: The PGS shall generate quick-look products in support of field experiments, event monitoring, and instrument monitoring using algorithms and calibration coefficients provided by the scientists.)

4. Locally Maintained Data Bases

   (Page 7-23, 3PGS-00490: The PGS shall have the capability to access and use for the generation of standard data products information stored in locally maintained data bases. Examples of such databases are: (a) Digital Terrain Map Database, (b) Land/Sea Database, (c) Climatologies Database, and (d) Digital Political Map Database.)

B. CONTROL

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL RESPOND TO CONTROL:

(Page 7-21, 3PGS-00270: The PGS shall provide a scheduler with the capacity to perform the following functions, at a minimum: (a) Add tasks to the job queue, (b) Allocate tasks among processors, (c) Initiate execution of tasks in the job queue, (d) Suspend execution of tasks, (e) Resume execution of a suspended task, (f) Cancel execution of tasks, and (g) Request and verify the staging and/or destaging of data stored in the DADS.)

C. PROCESSING STATUS INFORMATION

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL GENERATE FAULT INDICATIONS:

(Page 7-22, 3PGS-00320: The PGS shall display detected faults to the system operators.)

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL PROVIDE STATUS INFORMATION

(Page 7-22, 3PGS-00380: The PGS shall monitor its internal operations and generate a status report periodically.)

D. OUTPUT

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL PRODUCE:

1. Level-1 Data Products

   (Page 7-13, 3DAAC00070: The DAAC shall generate Levels 1, 2, 3, and 4 data products, archive, manage, quality check and account for archived data products.)

2. Processing Log

   (Page 7-22, 3PGS-00360: The PGS shall generate a PGS Processing Log periodically that accounts for all data processing activities.)

3. Metadata

   (Page 7-24, 3PGS00510: The PGS shall have the capability to generate metadata according to the algorithms provided by the scientists and associate this metadata with each standard data product generated.)

   (Page 7-14, 3DAAC00220: The DAAC shall generate browse data and metadata for routing to the requested users, through the coordination of IMS.)

4. Standard Browse Data

   (Page 7-24, 3DAAC00220: The DAAC shall generate browse data and metadata for routing to the requested users, through the coordination of IMS.)

5. Quick-Look Product

(Page 7-24, 3PGS-00530: The PGS shall generate quick-look products in support of field experiments, event monitoring, and instrument monitoring using algorithms and calibration coefficients provided by the scientists.)

E. OTHER

MODIS LEVEL-1 PROCESSING SHALL BE ACCOMPLISHED USING TWO DISTINCT SETS OF STAND-ALONE SOFTWARE: ONE SET TO SUPPORT MODIS-N PROCESSING AND ONE SET TO SUPPORT MODIS-T PROCESSING.

(Unreferenced)

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL BE CAPABLE OF REPROCESSING

(Page 7-24, 3PGS-00540: The PGS shall reprocess specified science data using new and/or updated algorithms provided by the scientists.)

(Page 7-24, 3PGS-00550: The PGS shall reprocess science data using the original or updated (provided by the scientists) calibration coefficients.)

THE MODIS LEVEL-1 PROCESSING SYSTEM SHALL BE CAPABLE OF PRODUCING LEVEL-0 DATA FROM LEVEL-1A DATA

(Requirement inferred from definition of Level-1A data)

MODIS LEVEL-1 PROCESSING SYSTEM FUNCTIONAL REQUIREMENTS OVERVIEW: DATA DICTIONARY

Ancillary Data: "Any data, other than standard products, that are required as input in the generation of a standard product. This may include ancillary data from the EOS platforms and the attached payloads, as well as non-EOS ancillary data. All ancillary data are received by the PGS from the DADS." (Page 7-17). Ancillary data does not include Locally Maintained Databases.

Anomaly Reports: A report identifying a discrepancy between two or more sources of information. (Unreferenced).

Audit Trail: A record that describes the processing history of data and its identification. Contained within the metadata. (Unreferenced).

Browse Data: "Data produced primarily to provide other investigators with an understanding of the type and quality of data available. Typically, browse data sets are limited in size or resolution. The specific form of browse data depends on the type of instrument or discipline with which the browse data are related. Browse data are sometimes considered to be a sample of available data." (Page A-3).

Control: "The PGS shall provide a scheduler with the capacity to perform the following functions, at a minimum: (a) Add tasks to the job queue, (b) Allocate tasks among processors, (c) Initiate execution of tasks in the job queue, (d) Suspend execution of tasks, (e) Resume execution of a suspended task, (f) Cancel execution of tasks, and (g) Request and verify the staging and/or destaging of data stored in the DADS." (Page 7-21). In addition are (h) Select processing mode and (i) Request processing status information.

Data Quality Check: The process by which data quality information is generated. (Unreferenced).

Data Quality Information: Information on data quality, including existence, completeness, and the presence of anomaly reports, at a minimum. (Unreferenced).

Fault Indication: An unsolicited flag denoting that a hardware or software error has occurred (e.g., a disk drive failed during data transfer or data header identifiers are not correct), or an "alarm event." (Unreferenced).

Instrument Data: "Data specifically associated with the instrument, either because it was generated by the instrument or included in data packets identified with that instrument. These data consist of instrument science and engineering data, and possibly ancillary data. These data may be assembled for transmission by the instrument, or by an on-board processor of the instrument data." (Page A-9). "Data created by an instrument including scientific measurements and any engineering or ancillary data which may be included in the instrument data packets." (Page A-9).

Instrument Status Information: "High level information about the status of an instrument stored in a designated DADS. These are redundant backup copies only. Primary backup copies are maintained at the ICC." (Page 7-34).

Level-0 Data: "Raw instrument data at original resolution, time ordered, with duplicities [sic] removed." (Page A-4).

Level-1 Data Product: A data set composed of Level-1A and -1B data product. (Unreferenced).

Level-1A Data Product: "Level-0 data, which may have been reformatted or transformed reversibly, located to a coordinate system, and packaged with needed ancillary, engineering, and auxiliary data." (Page A-4). Includes instrument data, a header, and data quality information.

Level-1B Data Product: "Irreversibly transformed values of the instrument measurements (e.g., radiances, marine conductivity). For in-situ observations, the Level-1B product is also the geophysical parameter of interest (e.g., particle flux, ambient magnetic field vector, radiosonde-generated atmospheric temperatures)." (Page A-4).

Locally Maintained Data Bases: "Examples of locally maintained data bases are: (a) Digital terrain map database, (b) Land/sea database, (c) Climatology database, and (d) Digital political map database." (Page 7-23).

Metadata: "Information which is obtained from data sets, and which provides an understanding of the content or utility of the data set. Metadata may be used to select data for a particular scientific investigation." (Page A-11). Metadata will include an audit trail. (Page 7-18).

Processing Log: "Periodically accounts for all data processing activities." (Page 7-22, 3PGS-00360). A record of the time-ordered processing events. An event may be the completion of the processing activity or the generation of an anomaly report.

Processing Mode: There are three types:

a. Standard Product Processing: "The PGS shall have the capability to produce each standard product as specified in that product's Standard Product Specification." (Page 7-23, 3PGS-00470).

b. Reprocessing: "The PGS shall reprocess specified science data using new and/or updated algorithms provided by the scientists." (Page 7-24, 3PGS-00540).

c. Quick-Look Data Processing: "The PGS shall send the DADS quick-look data for routing to the appropriate destination (e.g., ICC, SCF). Quick-look data shall contain the following information at a minimum: (a) Product

identication, (b) quick-look data, (c) associated metadata, (d) process facility identification, and (e) current date and time." (Page 7-30, 3PGS-01260).

Processing Performance: A statement of the amount of data processed; will include a record during processing (dynamic status) and a post-event record (static status). (Unreferenced).

Processing Status Information: "Information regarding schedules, hardware and software configuration, exception conditions, or processing performance." (Page 7-18). The MODIS Level-1 Processing System is concerned only with fault (exception) conditions and processing performance.

Quick-Look Data: "Real-time or priority playback data which receive minimal processing and are forwarded to the user for his review/use. The user may provide additional processing to suit his requirements." (Page A-14). "Data Received during one TDRSS contact period which have been processed to Level-0 (to the extent possible for data from a single contact). This is data that have been identified as requiring priority processing on the order of a few hours. It is routed to the PGS from the DADS." (Page 7-18).

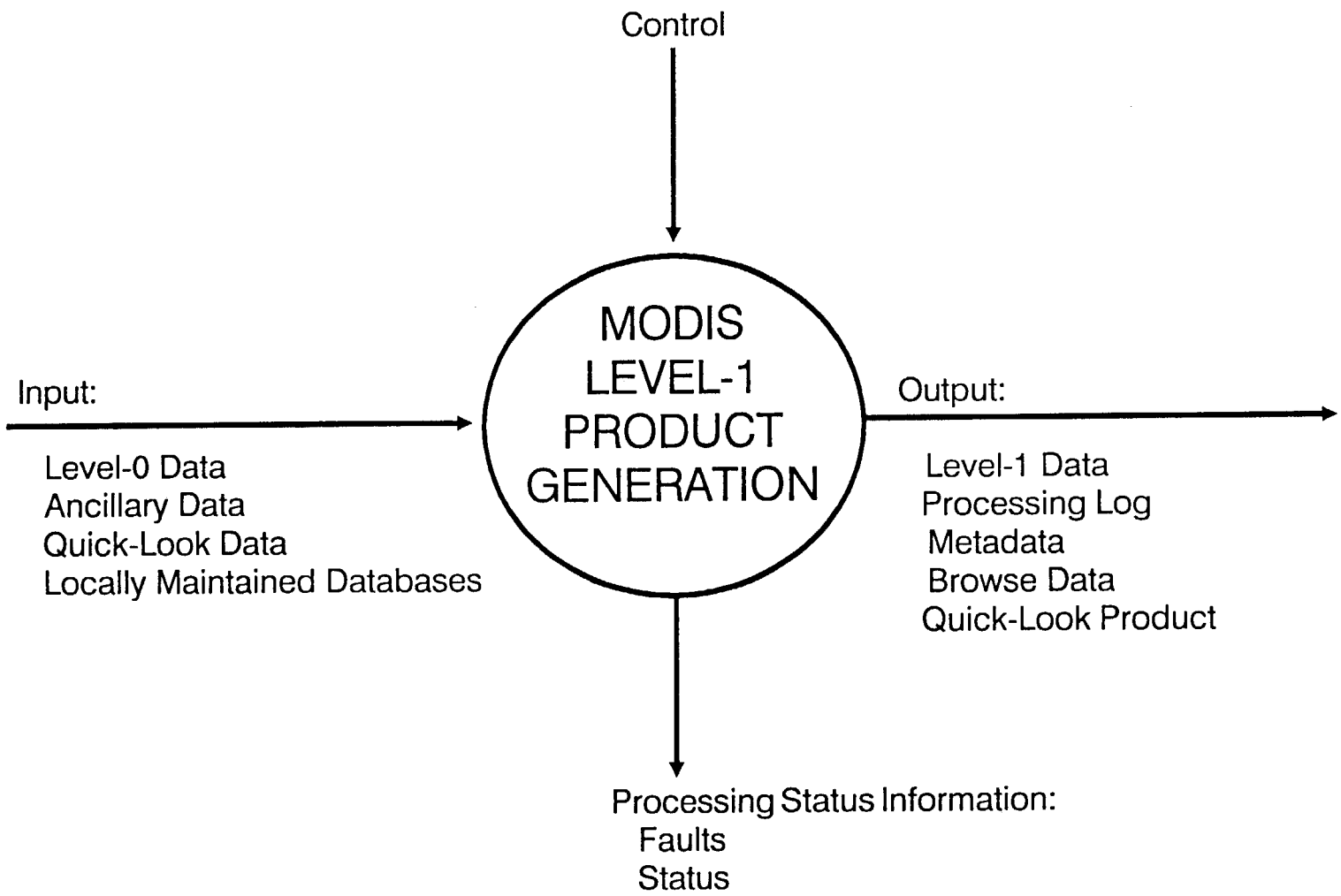
Quick-Look Product: "Quick-look data that has been processed by a PGS prior to being sent to an ICC." (Page 7-35). For MODIS Level-1 processing, the restriction on being sent to an ICC is relaxed--it may be sent elsewhere.

Spacecraft Ancillary Data: "Data available on board a spacecraft, derived from spacecraft parameters, or resulting from the on-board substitution of backup spacecraft parameters, but not produced by an instrument, which are needed for the processing or interpretation of instrument data. Spacecraft ancillary data comprises data referred to as "engineering", "core housekeeping" or "subsystem" data and includes parameters such as orbit position and velocity, attitude and its rate of change, time, temperatures, pressures, jet firings, water dumps, internally produced magnetic fields, and other environmental measurements." (Page A-15).

REFERENCE

Functional and Performance Requirements Specification for ECS, Fourth Preliminary, September 14, 1990.

MODIS LEVEL-1 CONTEXT DIAGRAM



MODIS LEVEL-1A PROCESSING SYSTEM FUNCTIONAL REQUIREMENTS OVERVIEW

A. INPUT

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL RECEIVE:

1. Level-0 Data

   (Page 7-23, 3PGS-00440: The PGS shall accept from the DADS L0-L4 Data Sets.)

2. Ancillary Data

   (Page 7-23, 3PGS-00450: The PGS shall accept from the DADS Ancillary Data Sets.)

   (a) Instrument Status Information required for data quality information
   (b) Spacecraft Ancillary Data required for navigation and data quality information

3. Quick-Look Data

   (Page 7-24, 3PGS-00530: The PGS shall generate quick-look products in support of field experiments, event monitoring, and instrument monitoring using algorithms and calibration coefficients provided by the scientists.)

4. Locally Maintained Data Bases

   (Page 7-23, 3PGS-00490: The PGS shall have the capability to access and use for the generation of standard data products information stored in locally maintained data bases. Examples of such databases are: (a) Digital Terrain Map Database, (b) Land/Sea Database, (c) Climatologies Database, and (d) Digital Political Map Database.)

B. CONTROL

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL RESPOND TO CONTROL:

(Page 7-21, 3PGS-00270: The PGS shall provide a scheduler with the capacity to perform the following functions, at a minimum: (a) Add tasks to the job queue, (b) Allocate tasks among processors, (c) Initiate execution of tasks in the job queue, (d) Suspend execution of tasks, (e) Resume execution of a suspended task, (f) Cancel execution of tasks, and (g) Request and verify the staging and/or destaging of data stored in the DADS.)

C. PROCESSING STATUS INFORMATION

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL GENERATE FAULT INDICATIONS:

(Page 7-22, 3PGS-00320: The PGS shall display detected faults to the system operators.)

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL PROVIDE STATUS INFORMATION

(Page 7-22, 3PGS-00380: The PGS shall monitor its internal operations and generate a status report periodically.)

D. OUTPUT

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL PRODUCE:

1. Level-1A Data Products

   (Page 7-13, 3DAAC00070: The DAAC shall generate Levels 1, 2, 3, and 4 data products, archive, manage, quality check and account for archived data products.)

2. Processing Log

   (Page 7-22, 3PGS-00360: The PGS shall generate a PGS Processing Log periodically that accounts for all data processing activities.)

3. Metadata

   (Page 7-24, 3PGS00510: The PGS shall have the capability to generate metadata according to the algorithms provided by the scientists and associate this metadata with each standard data product generated.)

   (Page 7-14, 3DAAC00220: The DAAC shall generate browse data and metadata for routing to the requested users, through the coordination of IMS.)

4. Quick-Look Product (Level-1A)

   (Page 7-13, 3DAAC00050: The DAAC shall provide the ICC with quick-look products for further evaluation of instrument operations and data quality.)

   (Page 7-14, 3DAAC00260: The DAAC shall produce quick-look products for priority transfer to the ICCs.)

E. OTHER

MODIS LEVEL-1A PROCESSING SHALL BE ACCOMPLISHED USING TWO DISTINCT SETS OF STAND-ALONE SOFTWARE: ONE SET TO SUPPORT MODIS-N PROCESSING AND ONE SET TO SUPPORT MODIS-T PROCESSING.

(Unreferenced)

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL BE CAPABLE OF REPROCESSING

(Page 7-24, 3PGS-00540: The PGS shall reprocess specified science data using new and/or updated algorithms provided by the scientists.)

(Page 7-24, 3PGS-00550: The PGS shall reprocess science data using the original or updated (provided by the scientists) calibration coefficients.)

THE MODIS LEVEL-1A PROCESSING SYSTEM SHALL BE CAPABLE OF PRODUCING LEVEL-0 DATA FROM LEVEL-1A DATA

(Requirement inferred from definition of Level-1A data)

MODIS LEVEL-1A PROCESSING SYSTEM FUNCTIONAL REQUIREMENTS OVERVIEW: DATA DICTIONARY

Ancillary Data: "Any data, other than standard products, that are required as input in the generation of a standard product. This may include ancillary data from the EOS platforms and the attached payloads, as well as non-EOS ancillary data. All ancillary data are received by the PGS from the DADS." (Page 7-17). For Level-1A, Ancillary data does not include Locally Maintained Databases.

Anomaly Reports: A report identifying a discrepancy between two or more sources of information. (Unreferenced).

Audit Trail: A record that describes the processing history of data and its identification. Contained within the metadata. (Unreferenced).

Control: "The PGS shall provide a scheduler with the capacity to perform the following functions, at a minimum: (a) Add tasks to the job queue, (b) Allocate tasks among processors, (c) Initiate execution of tasks in the job queue, (d) Suspend execution of tasks, (e) Resume execution of a suspended task, (f) Cancel execution of tasks, and (g) Request and verify the staging and/or destaging of data stored in the DADS.)" (Page 7-21). In addition are (h) Select processing mode and (i) Request processing status information. Two types of cancel operations are provided: (1) non-graceful (no output generated) and (2) graceful (output up to the cancellation point generated).

Data Quality Check: The process by which data quality information is generated. (Unreferenced).

Data Quality Information: Information on data quality, including existence, completeness, and the presence of anomaly reports, at a minimum. (Unreferenced).

Fault Indication: An unsolicited flag denoting that a hardware or software error has occurred (e.g., a disk drive failed during data transfer or data header identifiers are not correct), or an "alarm event." (Unreferenced).

Instrument Data: "Data specifically associated with the instrument, either because it was generated by the instrument or included in data packets identified with that instrument. These data consist of instrument science and engineering data, and possibly ancillary data. These data may be assembled for transmission by the instrument, or by an on-board processor of the instrument data." (Page A-9). "Data created by an instrument including scientific measurements and any engineering or ancillary data which may be included in the instrument data packets." (Page A-9).

Instrument Status Information: "High level information about the status of an instrument stored in a designated DADS. These are redundant backup copies only. Primary backup copies are maintained at the ICC." (Page 7-34).

Level-0 Data: "Raw instrument data at original resolution, time ordered, with duplicities [sic] removed." (Page A-4) .

Level-1A Data Product: "Level-0 data, which may have been reformatted or transformed reversibly, located to a coordinate system, and packaged with needed ancillary, engineering, and auxiliary data." (Page A-4). Includes instrument data, a header, and data quality information.

Locally Maintained Data Bases: "Examples of locally maintained data bases are: (a) Digital terrain map, (b) Land/sea, (c) Climatology, and (d) Digital political map." (Page 7-23). For Level-1A processing, only land/sea database and digital political map are required. These are required for the Level-1A metadata product.

Metadata: "Information which is obtained from data sets, and which provides an understanding of the content or utility of the data set. Metadata may be used to select data for a particular scientific investigation." (Page A-11) Metadata will include an audit trail. (Page 7-18). A more detailed description of the Level-1A metadata product is contained in the Appendix.

Processing Log: "Periodically accounts for all data processing activities." (Page 7-22, 3PGS-00360). A record of the time-ordered processing events. An event may be the completion of the processing activity or the generation of an anomaly report.

Processing Mode: There are three types:

a. Standard Product Processing: "The PGS shall have the capability to produce each standard product as specified in that product's Standard Product Specification." (Page 7-23, 3PGS-00470).

b. Reprocessing: "The PGS shall reprocess specified science data using new and/or updated algorithms provided by the scientists." (Page 7-24, 3PGS-00540).

c. Quick-Look Data Processing: "The PGS shall send the DADS quick-look data for routing to the appropriate destination (e.g., ICC, SCF). Quick-look data shall contain the following information at a minimum: (a) Product identication, (b) quick-look data, (c) associated metadata, (d) process facility identification, and (e) current date and time." (Page 7-30, 3PGS-01260).

Processing Performance: A statement of the amount of data processed; will include a record during processing (dynamic status) and a post-event record (static status). (Unreferenced).

Processing Status Information: "Information regarding schedules, hardware and software configuration, exception conditions, or processing performance." (Page 7-18). The Level-1A Processing System is concerned only with fault (exception) conditions and processing performance.

Quick-Look Data (Level-0): "Real-time or priority playback data which receive minimal processing and are forwarded to the user for his review/use. The user may provide additional processing to suit his requirements." (Page A-14). "Data Received during one TDRSS contact period which have been processed to Level-0 (to the extent possible for data from a single contact). This is data that have been identified as requiring priority processing on the order of a few hours. It is routed to the PGS from the DADS." (Page 7-18). At Level-0, these data are not necessarily time-ordered, complete, nor have duplicates removed, but are at original resolution.

Quick-Look Product (Level-1A): "Quick-look data that has been processed by a PGS prior to being sent to an ICC." (Page 7-35). At Level-1A, Quick-Look Products are not necessarily time-ordered, with duplicates removed, but are at original resolution, and are packaged with necessary ancillary and engineering data. The product is reversible to Level-0 Quick-Look Data. It includes instrument data, a header, but may not have data quality information.

Spacecraft Ancillary Data: "Data available on board a spacecraft, derived from spacecraft parameters, or resulting from the on-board substitution of backup spacecraft parameters, but not produced by an instrument, which are needed for the processing or interpretation of instrument data. Spacecraft ancillary data comprises data referred to as "engineering", "core housekeeping" or "subsystem" data and includes parameters such as orbit position and velocity, attitude and its rate of change, time, temperatures, pressures, jet firings, water dumps, internally produced magnetic fields, and other environmental measurements." (Page A-15).

REFERENCE

Functional and Performance Requirements Specification for ECS, Fourth Preliminary, September 14, 1990.

APPENDIX

LEVEL-1A METADATA ATTRIBUTES*	
FIELDNAME	DESCRIPTION
Algorithm Version Number	Version number and algorithm name
Archive ID	Archive location identifier
Attitude Information	Minimum and maximum yaw, pitch, and roll
Audit Trail	Processing history and identification
Coverage	Rectangular, circular, or elliptical coordintes
Data Gap	Includes orbit number, latitude/longitude, time span
Data Quality	Quality assessment of data granule
Data Type	Data type (ancillary, housekeeping, etc.)
Ephemeris Information	
Footprint	Bounding shape (rectangular, elliptical, or circular)
General Comments	General remarks
Geographic Location Keywords	Continent, ocean, or global location
Granule ID	Granule identifier
Image Description	General comments about image
Inventory Date	Date granule ingested into inventory
Number of Bands	Number of spectral bands
Number of Data Gaps	Number of missing lines in image
Number of Lines	Number of lines or scans in the data
Number of Observations	Number of observations included in data
Number of Samples	Number of samples or pixels in a line
Operation Mode	Description of operation mode
Platform ID	Platform on which sensor was located
Processing Date	Date the product was processed
Processing Level	Level of processing
Processing Location	PGS were product was processed
Product Sequence Number	Product identifier
Project ID	Supported project that collected the data
Scene ID	Input scene identifier
Sensor ID	Sensor which captured the data
Start Orbit Number	Orbit number at start of data collection
Stop Orbit Number	Orbit number at end of the data collection
Start Time	Date and time data collection started
Stop Time	Date and time data collection stopped
Storage Medium	Storage media
Tilt Angle	

*Derived from ECS Requirement Specification 9/14/90, Tables C-10 and C-11.